

Teaching visit from University of Umeå on 4th-8th of March within the scope of Erasmus+ by

Dr. Alp Yurtsever

Course Name: Introduction to Optimization for Data Analysis

Topic: Optimization techniques are central to the field of data science. Recent developments in data analysis and machine learning have highlighted the importance of optimization algorithms that use first-order derivative information and randomization techniques. This mini-course offers an introductory overview of these optimization methods. Starting with basic concepts like convexity and smoothness, we explore fundamental optimization techniques such as gradient descent and the stochastic gradient method. We also demonstrate these algorithms in practice through interactive computer lab sessions, applying them to real-world data science problems.

Schedule:

- Lecture on Optimization problems in Data Analysis and Machine Learning
- Interactive lecture on Foundations of Smooth Optimization
- Interactive lecture on Descent Methods
- Interactive lecture on Stochastic Gradient Techniques
- Lab with student computer projects, optional project presentations

Dr. Mehdi Moradi

Course Name: Point Processes: Fundamentals and Applications

Topic: Spatial point patterns, in practical terms, refer to the specific arrangement of individual points within a defined geographical area, referring to spatial locations of events/things. The application of spatial point patterns is instrumental in diverse fields, including e.g. ecology (for studying species distribution), epidemiology (for analysing disease clusters), urban planning (to optimise infrastructure layouts), traffic accidents (to reveal the high-risk streets) and criminology (for identifying crime hotspots). This course focuses on the fundamentals of spatial point processes, emphasising first-, second-, and higher-order analyses. Participants will explore the spatial distribution of events and the correlations between them. Utilising R, the program includes data handling, simulation studies and real-data analysis, with practical applications in studying phenomena such as forest fires, crimes, and traffic accidents.

Schedule:

- Interactive lecture on Introduction to Spatial Point Processes
- Interactive lecture on Intensity Estimation
- Interactive lecture on Second-Order Analysis
- Interactive lecture on Higher-Order Analysis
- Lab with student projects, optional project presentations

Dr. Konrad Abramowicz

Course Name: Discrete Events Simulation Approach in Practice

Topic: Discrete Event Systems can describe the time dynamics of various real-life processes, like queues, call centres, production systems and airports. The objective of the course is to introduce intuitive, user-friendly and very flexible SimEvents tools for simulating such systems. Starting from the simplest single server models, we introduce a variety of additional elements which can be used to model the complexity of real-life phenomena. We will also show how MATLAB machinery can be used to optimise such constructed models.

Schedule:

- Interactive lecture on Introduction to SimEvents
- Interactive lecture on Randomness and Routing
- Interactive lecture on Entity Structures and Attributes
- Interactive lecture on Time inhomogeneity and Matlab integration
- Lab with student projects, optional project presentations

Weekly Schedule

Day Hour	Monday	Tuesday	Wednesday	Thursday
09:00-12:30	Point Processes: Fundamentals and Applications, Dr. Mehdi Moradi (Seminar Room)	Discrete Events Simulation Approach in Practice, Dr. Konrad Abramowicz (Seminar Room)	Introduction to Optimization for Data Analysis, Dr. Alp Yurtsever (Seminar Room)	Point Processes: Fundamentals and Applications, Dr. Mehdi Moradi (Seminar Room)
13:30-15:00	Introduction to Optimization for Data Analysis, Dr. Alp Yurtsever (Seminar Room)	Introduction to Optimization for Data Analysis, Dr. Alp Yurtsever (Seminar Room)	'Exploring Data's Depths with Functional Data Analysis' SCITALK by Dr. Konrad Abramowicz (İbrahim Demir Conference Hall, Dept. of MBG Building, at 14:30)	Introduction to Optimization for Data Analysis, Dr. Alp Yurtsever (Seminar Room)
	Point Processes: Fundamentals and Applications, Dr. Mehdi Moradi (Mathematics Meeting Room - MMR)	Discrete Events Simulation Approach in Practice, Dr. Konrad Abramowicz (MMR)		Discrete Events Simulation Approach in Practice, Dr. Konrad Abramowicz (MMR)
15:30-17:00	Discrete Events Simulation Approach in Practice, Dr. Konrad Abramowicz (Seminar Room)	Discrete Events Simulation Approach in Practice, Dr. Konrad Abramowicz (MMR)		
	Point Processes: Fundamentals and Applications, Dr. Mehdi Moradi (MMR)	Point Processes: Fundamentals and Applications, Dr. Mehdi Moradi, (Seminar Room)	Point Processes: Fundamentals and Applications, Dr. Mehdi Moradi (Seminar Room)	